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QUESTIONS AND ANSWERS FOR USE IN THE INSTRUCTION OF TORPEDO COMPANIES AND DETACHMENTS

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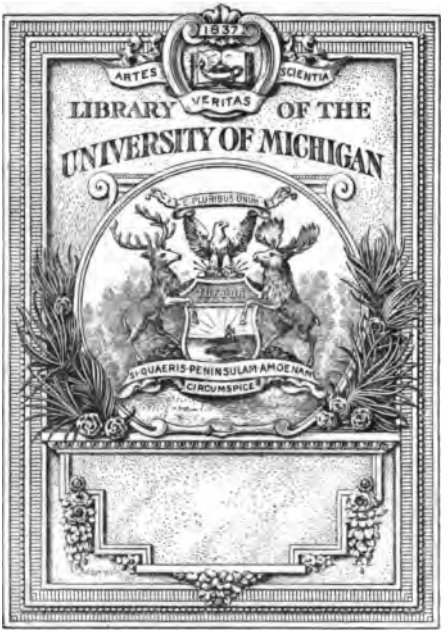
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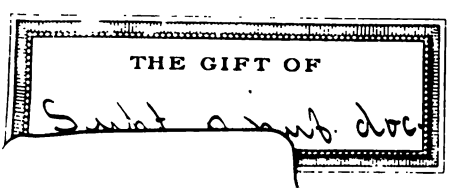
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U.S. WAR DEPARTMENT
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QUESTIONS AND ANSWERS FOR USE IN THE INSTRUCTION OF TORPEDO COMPANIES AND DETACHMENTS

(NEW SYSTEM)

WASHINGTON
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WAR DEPARTMENT.

Document No. 310.

Office of the Chief of Staff.

(2)

QUESTIONS AND ANSWERS

FOR USE IN THE

Instruction of Torpedo Companies and Detachments.

(NEW SYSTEM.)

Upon the recommendation of the Chief of Artillery, approved by the Secretary of War, the following is issued as a guide in the instruction of enlisted men in companies and detachments assigned to mine defense where the new system is installed.

MATERIAL OF, AND DUTIES IN, THE LOADING ROOM.

1. What apparatus is used in making a turk's head?

A navy knife, 1 pair cutting pliers, 1 hammer, 1 turk's head collar (large or small), 14 feet marline, are required.

2. What is used in making a telegraph joint?

Cutting pliers, navy knife, and a small file. If the joint is to be insulated add rubber tape.

3. What is used in making a joint to be put under water?

A navy knife, cutting pliers, file, rubber cement, rubber tape, tinfoil, and protective tape. A torch, or

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waste saturated with alcohol or oil, is needed for vulcanizing the joint. Brass jointers are used when authorized.

Before placing the joint in water, the turk's heads must be clamped in a distribution box or junction box.

4. Name all the parts of an assembled mine.

Mine case, mine cap, compound plug, complete—including plug proper, lower tube, fuze can cap, fuze can, mine transformer, ball seat, circuit-closer case, distance ring, springs, steel ball, 2 brass washers, 2 rubber packings, 1 brass follower, 1 steel follower, 3 lead washers, and set screws; loading wire, "C" wire, priming charge, 2 fuzes, 100 pounds of explosive, and ruberine.

5. Explain how to prepare a compound plug.

The transformer to be used is first tested for a good circuit between the red wires, a poor circuit between the black wires, no circuit between the red and black wires, and no circuit between either wire and case. The upper black resistance terminal is cut to 1½ inches in length, the end bared, and then clamped in the terminal stud in the neck of the transformer. The ball seat is then screwed home and the ball put in place. The circuit-closer case containing springs, distance ring and steel ball is then screwed home. (In preparing mines for service, before screwing up the threads of the circuit closer, transformer, fuze can, and plug proper are coated with ruberine or some similar waterproofing material. This is omitted when compound plugs are *prepared for drill* or for instruction purposes.) A piece

of "A" or loading wire, 20 feet in length, is fastened by a telegraph joint to the primary terminal and the joint is taped. This length is for convenience in testing and is cut off 15 inches from the compound plug when the mine is assembled for planting. This wire and the two secondary wires are drawn through the fuze can, which is then screwed on the transformer.

Two fuzes which have been tested for continuity of circuit are put on by telegraph or jointers joint in multiple across the secondary (red) terminals and the joints taped. The primer charge, about 1 pound of dynamite, is put in a cloth bag provided for the purpose, the fuzes embedded in the charge and the bag tightly tied around the neck. The charge is then pushed up in the fuze can. The loading wire is drawn through the fuze-can cap, a rubber packing pushed over it into its stuffing box, and a brass washer is threaded down so that it is close against the rubber packing. The follower is then screwed home with moderate pressure, and the lower tube is screwed into place, compressing a lead washer between it and the fuze-can cap. The loading wire is drawn through the hole in the plug proper and the latter screwed hard against the lower tube, a lead washer being used between them.

A rubber packing and brass washer are now placed upon the loading wire and forced into their seats in the plug proper by means of the follower, as in the case of the fuze-can cap. Special care must be exercised in forcing the followers home, as the insulation of the loading wire is liable to be pinched if the rubber pack-

ings are squeezed down too much. The plug is then tested with a circuit detector for poor circuit when in vertical position and for good circuit when turned beyond 45°. When a transformer is used, as in this system, this test may be made without any danger.

If it is desired to record the actual resistance with the plug in vertical and horizontal positions, this may be done by testing with a voltmeter; it is not really necessary and would be omitted if there were not an abundance of time.

In service if the loaded plug tests out satisfactorily all set screws are then set up.

Continuity of circuit of fuzes should be tested only under specific instructions of a commissioned officer.

6. What apparatus is used in preparing a compound plug?

Compound plug complete, as described in (4), bench vise, S-wrench, large monkey wrench, screw-driver, small pliers, navy knife, loading wire, cotton braided wire, priming charge, fuzes, rubber packings, brass washers, followers, lead washers, set screws, red lead or ruberine, circuit detector, brass jointers, rubber tape.

7. How are mines numbered?

Facing the direction from which the enemy is expected the mines in each group are numbered from left to right—No. 1 on the left.

Groups are numbered in a similar way; the outer left-hand group is No. 1, the next one to the right is No. 2, and so on through outer line; the left-hand group of next line has the number following that of the right-hand group of first line.

8. How are the mooring ropes prepared, and what are the rules for length of mine cables and of mooring ropes?

The mooring cables are cut off with square ends and the ends passed through the holes in the mooring sockets. The strands and wires are untwisted and spread out for a length equal to the length of the socket hole. The rope is then pulled back until the loose ends are about flush with the top edge of the hole; a piece of marline is tied about the rope below the socket. If necessary to hold the socket a piece of burlap may be wrapped around below the socket and a fold allowed to fall over the hand. Generally means can be found to set the socket upright while pouring full of alloy. Great care must be taken to see that there is no water or surplus oil on the socket or mooring rope before pouring the alloy.

Mines are planted with a submergence of 5 feet below mean low water.

Where ordinary anchors are used the mooring ropes must be prepared for depths obtained by sounding. If sockets are used, the ropes for No. 32 cases are but 10 feet less than the ascertained depths at mean low water. This allows 5 feet for submergence and 5 feet for the mine, mine bail, sockets, shackles, and anchor. For the larger mine cases an additional allowance must be made for the length of the cylindrical part of the case. Finally each mooring rope is tagged at each end with the number of the corresponding mine.

Mine cables are cut to the following lengths plus twice the approximate depth of water:

	Feet.		Feet.
No. 1	1,425	No. 11	425
No. 2	1,225	No. 12	475
No. 3	1,025	No. 13	525
No. 4	825	No. 14	625
No. 5	725	No. 15	725
No. 6	625	No. 16	825
No. 7	525	No. 17	1,025
No. 8	475	No. 18	1,225
No. 9	425	No. 19	1,425
No. 10	375		

Each end of each cable is tagged with the number of the corresponding mine.

MATERIAL FOR AND DUTIES ON THE WATER.

1. What apparatus is taken out on the distribution box boat?

One distribution box, 1 buoy for same, 1 mooring rope for attaching buoy to distribution box, 1 anchor sufficiently heavy to hold distribution box boat, 1 anchor buoy (keg) and rope for same, 2 anchor shackles (1 for anchor and 1 for box), 1 pair field glasses, alcohol, 2 alcohol lamps, cable tags, turk's head, collars, cotton waste, 2 files, 2 hammers, 2 heaving lines, knives, marline, 2 marline spikes, 1 megaphone, 2 monkey wrenches, 2 pliers, protective tape, rubber cement, rubber tape, 2 scissors, tinfoil, telephone, brass connectors, lashings.

The planter may locate the distribution box boat anchor and in that case it, together with its buoy and rope, *would not* be taken out in the distribution box boat.

2. How and in what way are the cores of cable numbered?

They are numbered by the noncommissioned officer in charge of the boat, who establishes communication with the casemate, using the boat telephone, and working under the instructions of the casemate electrician.

Nos. 1, 13, and 19 are easily selected by means of their special marking; No. 19 is the center core; No. 13 is the marked core in the inner row of six, and No. 1 is the marked core in the outer row of twelve.

In the seven-cored cable there are no marked cores, the cores being numbered under instructions of the casemate electrician.

3. How is a mine, together with its attachments, arranged for planting?

A reel of single conductor cable is placed on board the planter and put on the jacks. A piece 20 feet long is cut off the end to eliminate the part which was above water during storage. The cables for the mines are now unreeled, cut to the prescribed lengths and tagged with the number of the corresponding mine.

The cable for No. 19 mine is carried back on the port side and coiled in a figure eight on the after deck, the tagged ends being brought up forward. The figure eight is lashed with pieces of small rope around the center and at the turns. A mine cap is slipped over the end from the bottom of the coil and turk's heads are made on each end.

The cable for No. 1 mine is prepared likewise, being carried back on the starboard side. This is repeated until *all* nineteen cables are ready; the coils are piled on

top of each other. The cables for Nos. 1 to 9 are on the starboard side, those for Nos. 10 to 19 are on the port side.

While the cables are being prepared the mine buoys, anchors, mooring ropes, raising ropes, shackles, sister hooks, etc., are gotten aboard and placed forward, the proper supply on either side. The anchors are placed as convenient to the forward davits as possible.

Finally the loaded mines are put aboard. If they contain dynamite they should be protected from the direct rays of the sun by being covered with paulin.

The detail on each side of the planter prepares a mine on its own side. The loading wire from the mine is cut to the proper length, a taped joint is made with the single conductor of the corresponding cable, and the mine cap is fastened on. The cable is lashed with marline to the bales just above the ring.

The proper mooring rope is now shackled at one end to an anchor, at the other end to the mine, and is lashed to the mine cable with marline at every 5 feet. (If automatic anchors be used, this lashing is omitted.)

A rope for raising the mine is cut to the length of 50 feet plus the depth of water. One end is attached to the anchor by an anchor knot, the other to the mine cable by two half hitches and a seizing of marline. It should not be secured at other points. The use of this is explained later.

The mine buoys have attached to them 60 feet of small rope, which is marked at every 5 feet. The free *end is slipped through* the maneuvering ring of the *mine and tied to* the buoy.

The anchor is now slung to a tripping hook below a differential block on the forward davit and is hoisted and swung clear of the rail. The mine is similarly slung by its maneuvering ring from the after davit and a heaving line is bent onto the free end of the mine cable. Both mine and anchor are lowered as close to the water as conditions will permit. Before slinging the mine and anchor the release of the tripping hook must be lashed well with marline, which is cut after they have been lowered. A mousing must also be put around the upper hook of the differential block. The aft detail now removes or cuts the rope lashings of the coil of the corresponding mine cable and sees that all cables, ropes, etc., are cleared ready for planting.

The planter moves out toward the buoyed line and passes as close as possible to the distribution box boat, with the latter to port. As it passes slowly by, the heaving line is thrown by a man well forward to the distribution box boat, whose party immediately haul in the mine cable, insert the turk's head in the corresponding slot, No. 10, of the distribution box, and lash the cable to the boat. (If the water be rough, the cable end is passed to the boat by a launch.)

The planter then moves out to the central buoy which marks the position of mine No. 10. As the forward davit comes abreast of the buoy, the officer in charge of the planting commands "Let go;" the tripping hook of the anchor is released first and that of the mine immediately thereafter.

(CAUTION.—*The men operating the tripping hooks must be very careful that they stand back of all cable, rope, etc., so that they may not be caught. All others must stand clear.*)

The planter then executes a sweeping circle to starboard, passes to the rear and comes up with the distribution box boat to starboard. As it moves by, the free end of mine cable No. 9 is passed to the boat and secured as before. The planter moves ahead to a point 100 feet to the left of mine No. 10, and as it crosses the line plants mine No. 9, swings off to port, circles and comes up from the rear with the distribution box boat to port, and so on alternately until all the mines are planted.

As soon as a mine is dropped, the detail for that side of the planter prepares another for planting. There is ample time to do this while the vessel is turning and planting the other mine.

4. Name the apparatus on the boat used in planting mines.

Derricks, catheads, snatch blocks, steam winches, insulated cable, cable-drum frames, circuit detector, boat hooks, sounding lines graduated to feet, davits, differential blocks, mooring ropes, raising ropes, buoyant mines and anchors, shackles and extra split pins for same, lashing rope, alcohol, 2 alcohol lamps, 1 cable cutter, cable tags, turk's head, collars, cotton waste, 4 files, 4 hammers, 6 heaving lines, knives, marline, 2 marline spikes, 1 megaphone, 2 monkey wrenches, 4 pliers, protective tape, rope, rubber cement, rubber tape, 2 scissors, 1 set of stencil numbers, tin foil, and a measuring line which has marks every 100 feet, with double marks at 300 and 600 feet.

CORDAGE.

1. Name the important knots used in mine work.

Square knot, fisherman's bend, single becket bend, double becket bend, stopper, clove hitch, blackwall hitch, cats'-paw, rolling hitch, mooring knot, slip knot, timber hitch, bowline, sheepshank, running bowline, bowline on a bight, figure of eight, short splice, throat seizing, round seizing.

2. The mooring rope of a heavy weight can not pass over the winch, but lifting must be done with the fall; explain the method of proceeding.

This condition may be brought about when there are knots in the raising rope that will not pass through the snatch block.

Make a cats'-paw in the raising rope, and place it over the hook of the fall. Raise the fall as high as it will go. Put a stopper around the raising rope. Slack away on the fall. Make another cat's-paw above the stopper and place it over hook of fall. Continue as above until weight of anchor is high enough to swing in-board.

CARE AND PRESERVATION OF MINE MATERIAL.

1. Name the supplies necessary for cleaning mine material.

Cotton waste, kerosene, sandpaper, emery cloth, alcohol, scrapers, wire brushes.

2. Name those used in preserving it, stating for what each is used and how they are applied.

Cosmic, white lead, red lead, raw linseed oil, turpentine, drier, lampblack, beef tallow (rendered), pumice stone, varnish, asphaltum varnish, paint brushes.

When oil engines or motor generators are out of commission their bright parts should be covered with cosmic. Brass screw threads and parts of tools that are liable to rust should also be so smeared. In all cases where cosmic is used on bright surfaces to prevent corrosion it should be applied four times a year.

Screw threads of mine cases, steel screw threads of compound plugs, bolts, nuts, and washers, and surfaces of flat joints should be kept smeared with a slushing grease made of 1 part white lead and 4 parts beef tallow (rendered). No oils or grease should ever be placed on points where metallic contact of electrical instruments are necessary, nor on india rubber, ebonite, or slate.

Mine cases should rest on racks or skids, and where space permits should not be in contact with each other. In handling mine cases care must be taken not to damage the bails or bolts. They should be so arranged that the holes in the mine cases can be easily seen; these holes should be fitted with a wooden plug which has been thoroughly greased all over its surface. New mine cases, if galvanized, usually will not need painting until they have been in the water. When taken from the water they should be thoroughly dried, and if they should show signs of rust, they should be gone over thoroughly with steel-wire brushes until the rust is removed. Parts which can not be reached with the brush should be cleaned with three-cornered steel scrapers. A heavy coat of red lead should then be applied; *7 gallons of this* paint can be made by mixing 100

pounds of red lead ground in oil with 5 gallons of raw linseed oil. This mixture should be applied within two or three weeks after mixing. One gallon of paint should give ten mine cases one coat. After this coat has been allowed to dry there should be applied a coat of white lead toned down to a neutral gray. Seven gallons of this paint can be made by mixing 100 pounds white lead, 2½ gallons raw linseed oil, 2½ gallons turpentine, 1 gallon liquid drier, and adding about 1 pound of lampblack to tone down the mixture.

Should loose paint or rust be seen the case should be repainted. A small wooden mallet may be used to tap the case at all points to loosen scales of rust or paint; then the surface should be thoroughly wire brushed or scraped and the cases repainted as stated above.

If the oil engine has not been painted, it should be given a priming coat of red lead mixed in oil. This should be rubbed down with pumice stone and two coats of steel-colored paint applied. The second coat should be rubbed down and two coats of varnish then applied. After this the engine should not need repainting for a couple of years. When, however, repainting is necessary, the engine should be rubbed down until all varnish is removed and a coat of steel-colored paint applied. This coat should be rubbed until no brush marks remain, and one or two coats of varnish should then be applied. The steel-colored paint should be applied flat—that is, the color which is ground in japan should be mixed with turpentine. One gallon of this paint is more than sufficient to give an engine two coats.

The motor generators and casemate transformer u ally will not need the priming coats of red lead, as tl generally come from the factory painted. When it necessary to paint them, one coat of the steel-colo paint and one of varnish will usually be found su cient.

Anchors, distribution boxes, mooring sockets, sh kles, sister hooks, junction boxes, and the iron work operating boards and power panels should be pain with asphaltum varnish.

Paint brushes, when new, and before using, sho be wrapped or bridled with strong twine and soaked water to swell up. After using, they should be clea with turpentine and put away in water to keep th from drying and becoming unpliable.

Large ropes should be stored on skids, allowing free circulation of air. Small ropes should be hung wooden pins. Ropes should be uncoiled semiannua in dry seasons and stretched out for several days dry.

HIGH EXPLOSIVES.

1. What high explosives are used in mines?

Dynamite, wet gun cotton, and in emergency ot commercial high explosives.

2. What are the important precautions to be observed loading mines?

In handling boxes of high explosive, the greatest c must be observed. Rubbers must be worn by those *tering the* magazine. The boxes must not be drop

or slid either upon one another or upon the floor or skids, but must in every case be lifted bodily. They must not be left exposed to the direct rays of the sun nor stored in a building in which the temperature rises unduly.

In loading mines only one box of explosive for each loading party is brought to the loading room at a time. As soon as dynamite is removed from the boxes, they, with their sawdust packing, must be carefully removed to a safe place and subsequently burned. A piece of bagging or canvas is spread upon the floor in the loading room, and the mine case is placed on this on skids. The loading funnel is placed in the opening in the case, and the cakes or cartridges are passed in by hand until the entire charge has been inserted. In loading dynamite the cartridges should be handled with rubber gloves and should be brushed off over the box as they are removed. Constant care is taken that no small particles of this explosive are dropped where they might be trodden under foot or subjected to friction in moving the mine case. The floor is frequently swept, the dust, litter, pieces of paper, etc., being removed to a distance and burned. The cartridges are so placed that they will not be torn up by the compound plug when the latter is screwed home. When the charge has been inserted, the funnel is removed and the threads very carefully cleaned with a soft brush. Before inserting the compound plug the threads are completely smeared with ruberine or some similar substance.

For a charge of dynamite the primer charge is 1 pound of loose dynamite contained in a small bag, which fits easily into the fuze can. In filling the bag, rubber gloves must be worn. To insert the fuzes, the bag is opened and the fuzes are embedded in the explosive, the choke of the bag being then tied around the fuze wires.

For a charge of wet gun cotton, the primer charge is of dry gun cotton. This may be either of crumbled gun cotton or of cakes cut to fit. The compressed primers are supplied wet and consist of three cakes, one of which is bored with two $\frac{9}{16}$-inch holes to receive the fuzes.

It is essential that the gun cotton primer be thoroughly dry. It is not safe to saw or bore a dry gun cotton cake.

The mine fuze is the regular commercial electric fuze, double strength, extra quality, and containing 24 grains mercuric fulminate. The lead wires need not be over 7 inches in length.

Mines charged with wet gun cotton may be safely unloaded, using ordinary precautions. The compound plug being unscrewed, the cakes are removed by hand, repacked in the original boxes, a little fresh water added, and the boxes closed.

In unloading mines charged with dynamite too many precautions can not be taken. The mine should be held either in an opening in a raft, or behind an earthen traverse, and the compound plug removed by some arrangement which may be operated from a safe distance. *If the mine* has been planted for some time, the *recovered dynamite* is usually destroyed.

Sometimes the mine cases will be found to be coated with an extremely sensitive film of exuded nitroglycerin. This film may be destroyed by filling and thoroughly rinsing the case with "sulfur solution" prepared by boiling 20 pounds of powdered sulfur and 50 pounds of lime in a barrel of water.

3. How is frozen dynamite thawed?

The thawing of it near a stove is strictly prohibited. The best method is to leave the boxes open for several hours in a warm room. If time be lacking, the dynamite may be thawed by placing it in an open, watertight can and placing the can in warm water not hotter than can be easily borne by the hand.

4. Where is the main supply of explosive kept, and how much is taken out at one time to the explosive house near the loading room?

It should be kept in cool magazines, in which the temperatures does not fall below 45° F., and where there is no dripping of water. Only so much is taken to the explosive house as is needed for immediate use.

THE PLOTTING BOARD.

1. Describe the plotting board.

The plotting board is a smooth, usually semicircular board of such size that with a suitable scale, 100 or 150 yards to the inch, the positions of all the mines and of the primary and secondary stations may be located with respect to each other on a sheet of paper fastened to it. The radius of the board supplied by the Ordnance Department is 40 inches.

Mounted on the board and pivoted one at the location of primary station and the other at secondary station are two graduated metal arms. The scale on the arms should ordinarily be 100 or 150 yards to the inch. Each arm has a corresponding azimuth circle with degrees numbered with respect to a fixed line.

By using an auxiliary arm supplied on boards issued by the Ordnance Department only one circle with separate graduations for each station is necessary.

By means of index boxes at the outer ends of the arms they may be set to hundredths of a degree and locked in position for all necessary azimuths from the station to which each arm corresponds. The intersection of these arms which have been set to simultaneous azimuths from the two stations gives the location of the target for the instant the observations were taken.

2. Explain the method of computing the time from any plotted point to a mine.

Positions are plotted at some fixed interval, say every 20 seconds. Knowing the distance traveled in 20 seconds, which is readily determined by measuring with a speed rule, we can determine the speed of the target. Knowing the speed of the target and how far it must travel until it will come within the destructive radius of a mine, we can determine how many seconds will elapse from the time of the last plotted position until the command " fire " is given. It will be seen that the time for a target to travel from any plotted point to a *mine* will depend on two things—the speed of the tar*get and its distance* from the mine. Graphical tables

have been constructed with all values of the speed and distance likely to occur in practice. A speed rule is furnished for measuring distances on the plotting board. It is only necessary to refer to the table to take out the desired time.

3. Act as plotter.

This should be done at the plotting board. Briefly the method is as follows:

An assistant No. 1 sets the arm at the angle as given from the primary station. No. 2 sets his arm at the angle as observed at the secondary station at the same instant. The intersection gives the position of the target at the instant and is plotted by the plotter. Successive positions thus determined will give the course and the speed of the target. It is thus possible to determine if the target will cross the plotted position of a mine and how many seconds will elapse before that event will occur. Accuracy and speed are both necessary, but the former must not be sacrificed for the latter. Speed will come with practice.

BATTERIES, GENERATORS, AND SEARCHLIGHTS ASSIGNED TO THE COMPANY.

1. Name the batteries used in mine work.

Casemate battery, consisting of 40 storage cells, and boat telephone battery, consisting of sufficient dry cells to give approximately 15 volts.

2. Describe the casemate battery.

This is a 40-cell chloride accumulator with a normal charge and discharge rate of 5 amperes. The voltage

may be taken at 2 volts per cell. The type of cell is D–5, in which the letter denotes the size of plate, and the figure the number of plates per cell. In the type used for the submarine mine work, there are two positive plates and three negative plates in each cell. The positive plates are of a brownish color, sometimes called plum colored. The negative plates have a grayish color. When the battery is set up, the cells rest on sand trays and the trays on glass insulators. This is to thoroughly insulate the battery. The jars are partly filled with electrolyte, which is a mixture of sulphuric acid and water, having a specific gravity of 1.210.

3. What precautions are necessary to keep it in order?

When the battery is in regular service, the discharge should not be continued below 1.8 volts per cell at full load. The charging should be started at once after a discharge and continued until the battery is fully charged. The cells must never be allowed to stand discharged. If by chance this should happen, the charging must be proceeded with at half rate.

The battery should be discharged and charged at least once a week and record must be kept of each cell, showing its voltage and specific gravity. It is customary to read the voltage just before the end of the charge and the specific gravity immediately after shutting off the charging current. Cells must be inspected for short circuit and, if any exist, a piece of hard rubber or glass used to remove them. Metal must not be used under any circumstances. Water should be added to the cells at the beginning of the charge to bring the

electrolyte to the proper height. When the specific gravity of the electrolyte at the end of an overcharge and at normal temperature has fallen to 1.190, it should be brought up to standard by the addition of 1.400 acid instead of water, when replacing evaporation, provided the cell is in good condition otherwise. The indications of a full charge are the appearance of the plates—the deep chocolate color of the positive plates and the light slate color of the negative plates; the gassing of the cells; the readings of the voltmeter, about 2.50 per cell; the specific gravity of each cell near 1.210.

4. Describe a searchlight.

The essential parts of a searchlight are a reflecting surface placed behind a light together with some means of directing the reflected rays in any desired direction. All the searchlights in the United States service are fitted with parabolic ground glass, silver plated mirrors or parabolic metallic gold-plated mirrors for reflection surfaces. The reflectors are furnished in the following sizes: 18-inch, 24-inch, 30-inch, 36-inch, and 60-inch. For artillery purposes probably the 36-inch and 60-inch lights will be employed. These two may be controlled by hand or by an electric controller at the will of the operator. There are means provided for adjusting the carbons so as to bring the electric arc into proper focus. The carbons are fed toward each other automatically, means being provided for feeding the positive carbon twice as fast as the negative to allow for its more rapid consumption. Other parts of the searchlight are motors for traversing and for elevating

and depressing; controller switch; focusing screw; socket for inserting wrench to operate lamp switch used for cutting out feeding magnet; socket for inserting wrench when feeding by hand; wheel for slow vertical movement; wheel for slow horizontal movement; base; carbon holders; lamp; doors for adjusting the carbons and for cleaning the front door.

5. Describe parts of generators and important points to be observed in caring for them.

The principal parts of the generator are: The armature, brushes and holders, commutator, field coils and magnets, frame, and base plate. The generator should be kept clean and dry. If the casemate is damp it may be necessary to take special precautions against dampness, wiping off the moisture so far as possible and drying out the casemate with an oil stove, if other means of heating have not been provided. When moisture is present, it is well to run the generator, as this will help to dry the machine.

The belt between the engine and dynamo should not be too tight. The dynamo should be fastened to a firm foundation with anchor bolts and should be well insulated by using a layer of dry wood between the concrete and the base plates. The best dynamo oil should be used for the bearing. Commutators should be clean and smooth, and the brushes should fit on them with large contact surfaces. The commutator should be cleaned occasionally with a little oil or vaseline, being *carefully wiped* as dry as possible after cleaning. The *machine should run* smoothly without any unusual

noises and without undue heating of its bearings on account of friction. The armature of the casemate machine is not well ventilated, and it heats unduly. The machine must be carefully watched and on the first sign of undue heating the dynamo should be stopped and allowed to cool. Water should never be poured on it to cool it. The brushes should be so adjusted that, when running at full speed, no sparking occurs at either end.

The best position of the brushes is found by trial, and the position should then be marked so that if disturbed they can be put back in place readily. The machine should be covered when not in use. All electrical connections should be clean and firmly made. Any unnecessary resistance in circuits between casemate battery and switchboard and between dynamo and switchboard is harmful and should be guarded against.

CASEMATE APPARATUS AND ITS CARE AND OPERATION.

1. Name the apparatus on the power and operating panel.

The power panel has mounted on it: A milli-ammeter and protecting lamp, a double-pole circuit breaker, a single-pole reverse current circuit breaker, a two-way direct current ammeter, a direct-current voltmeter, an alternating current voltmeter, double-pole double-throw lever switches, double-pole single-throw lever switches, receptacles, plugs, switchboard lamps, direct current bus bars, alternating current bus bars, charging rheostat, field rheostat, special resistance for reverse current circuit breaker, terminal strips, fuses, fuse clips and necessary connections.

The operating panel has mounted on it 1 signal block, 1 master block, 19 mine blocks, a cable terminal block, brass bus bars and necessary connections.

The signal block has mounted on it a single-stroke signal gong, a single-pole gong switch, 16-candlepower 45-volt red lamp and base, 16-candlepower 110-volt white lamp and base, 16-candlepower 45-volt green lamp and base, resistance coil in parallel with white lamp with clips, earth (or bell) terminal, alternating current terminal, and direct current terminal.

The master block has mounted on it an A. C. jaw, a D. C. jaw, testing switch, and a firing switch. A jumper with terminals is provided for use with A. C. and D. C. jaws.

Each of the 19 mine blocks has mounted on it: One single pole double throw testing switch, 1 single pole double throw automatic switch with through pin for closing red lamp and bell circuit, 1 mine switch, and 1 D. C. power switch; necessary connections to bus bars and terminal block, and 2 screws for mounting block on frame are also provided. Mine blocks even if of different makes are interchangeable among different panels or on same panel. The terminal block is provided with 19 numbered binding posts and clips.

2. Describe the motor generator, casemate transformer, mine transformer, and boat telephone.

The motor of the motor generator is a $1\frac{1}{3}$-horsepower bipolar D. C. shunt machine designed to operate on a *voltage of from* 80–110. This motor is direct connected *to a 4 pole* single-phase A. C. generator, giving a

voltage approximately equal to that impressed on the motor.

The casemate transformer is a one-half kilowatt step-up transformer, ratio 79:500; the oil used to cool the coils is ordinary transformer oil and the case should be kept filled with this oil.

The mine transformer is a step-down transformer with a high resistance primary. The circuit is completed through this primary by grounding one end to the case. Further details of the mine transformer will be supplied by the instructor if necessary.

The boat telephone is a hand telephone consisting of transmitter, receiver, condenser, buzzer, talking key, calling key, and a small nickel-plated metal case containing all the above-mentioned parts. There is a choke coil between each side of the 15-volt battery and the line. Both coils are inclosed in one case. This set of coils is not necessary unless there are two or more lines being operated simultaneously from the same battery.

3. Explain how to set the power panel and operating panel for automatic firing.

(*a*) See that all lamps on signal block are screwed home and bell switch closed.

(*b*) See that all four switches on each mine block are closed *up* (i. e., testing switch, automatic switch, mine switch, and power switch), *except* on blocks belonging to mines which have been fired. On these blocks the power and mine switches should be open.

(*c*) At the power panel. Put power on D. C. buses *in one of the* following ways:

1. Close both poles of double pole circuit breaker, or
2. Close single pole reverse current circuit breaker and switch No. 2 to the right, or
3. With engine and casemate generator running, close single pole reverse current circuit breaker and switch No. 2 to the left.

In each of the three cases (1), (2), and (3) put plug in proper receptacle to give on D. C. voltmeter the voltage of circuit to be used. Read voltmeter to see if proper voltage is on the busses. For storage battery (1) this should be from 80 to 85 volts. For post power (2) this would be probably from 110 to 125 volts. For casemate generator (3) this should be 80 to 110 volts; regulate this to value desired by means of field rheostat.

(*d*) Close switch No. 3 up.

(*e*) Close switch No. 4 up (or down).

(*f*) Close switch No. 9 up (or down).

(*g*) Put A. C. plug in proper receptacle and read A. C. bus bar voltage.

This should be at least 500 volts. If storage battery is on busses and the A. C. bus bar voltage does not read at least 500, raise to 500 by cutting out resistance of charging rheostat.

(*h*) Close switch No. 8 up.

(*i*) Examine all automatic switches again and if any of them are down close them up, and if any one will not remain closed by adjusting the solenoid plunger open the power switch on this particular mine block.

(*k*) Close firing switch.